

## Lab 2. Capacitors

**Name:** \_\_\_\_\_

**Section:** \_\_\_\_\_

**Due at the beginning of Lab.**

### Task 3. The First Assignment

You have accepted the position of a design engineer with a company producing capacitors, inductors and other electrical devices.

Your first assignment is to design a parallel-plate capacitor according to a list of specifications.

- (1) capacitance 80 pF;
- (2) voltage rating 120 V;
- (3) safety factor 10;
- (4) The metal foil, from which the capacitor's plates are to be fabricated, comes in 2-mm wide strips and its price is 0.02 USD for a 1-m long strip.

You are given a long list of different dielectric materials that can be used as the insulator. Their properties, namely, relative permittivity, dielectric strength, and price per unit volume, are known.

Because you are happy with your new position and you do not want the company to collapse (and most important, you don't want to get fired) you need to come up with **the least expensive** design.

**Briefly outline the algorithm (steps) you will be following in order to design the capacitor.**

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### Task 4. The Second Assignment

Your boss was very impressed with the quality and the speed of your work on your first assignment. A few more good deeds like this and your promotion would be on its way.

Sure enough, your next assignment follows quickly. Now, you are to design a cylindrical capacitor. The list of specifications now includes:

- (1) capacitance 5 pF;
- (2) voltage rating 4 kV;
- (3) safety factor 10;
- (4) inner conductor diameter 4 mm;
- (5) outer conductor diameter 10 mm.

For the dielectric filling, you are to use mainly polystyrene. You may add a thin layer of mica if needed. The thing is that mica has better properties but is much more expensive than polystyrene. Therefore, the amount of mica used in the capacitor must be minimized or, even better, avoided.

Material	Dielectric constant	Dielectric strength (MV/m)	Price (USD/cm <sup>3</sup> )
Polystyrene	2.7	21	2.70
Mica	6.0	200	25.00

**Try to design the capacitor using polystyrene only. What is the problem with your design? Provide values to prove your statement.**

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